range. If PWM/ESR is controlled using Ta as the control variable, then when it fails, the control is done as follows. The above said actuator is controlled based on Ti, or the Ta values are estimated using the learned dT (i.e., add dT to Ti value to estimate Ta). During pull down, the valve/PWM can be set to full-open/load for the learned pull-down time (tpd). If Ti also fails at the same time or is not available, the actuator is opened 100% during pull down time and then set to steady-state loading percent (SSLP) after pull-down-time. An alarm is sent to the supervisor upon such a condition.

Degraded Expansion Valve

If an expansion valve sticks or is off-tuned or is undersized/oversized, the following combinations of the tracked variable can be used to diagnose such problems. N_FL>50% and ER_new%>10% indicate the expansion valve is stuck open or is off-tuned or may be even oversized and thus is flooding the evaporator coil. An alarm is sent upon such a condition. Moreover, SH>20 and N_FL=0% indicate an off-tuned expansion valve or an undersized valve or the valve is stuck closed.

Degraded ESR Valve/PWM Compressor

A degraded ESR is one that misses steps or is stuck. A degraded PWM Compressor is one whose solenoid is stuck closed or stuck open. These problems are detected in a configuration where defrost is performed by setting the ESR/PWM to 0%. The problem is detected as follows.

If ER_new%>50% before defrost and during defrost Ti<32□ F. and SH>5□ F., then the valve is determined to be missing steps. Accordingly, the valve is closed by another 100% and if Ti and SH remain the same then this is highly indicative that the valve is stuck.

If ER_new%=0 and N_Close is 100% and Ti<32 F. and SH>5 F. then PWM/ESR is determined to be stuck open. If ER_new%=0 and N_Open is 100% and Ti>32 F. and SH>5 F. then PWM/ESR is determined to be stuck closed.

Over-sized ESR/PWM

If N_Close>90% and 30%<ER_new%<100%, then an alarm is sent for oversized valve/PWM Compressor.

Under-sized ESR/PWM

If N_Open>90% and ER_new%=0 and SH>5, then an alarm is sent for undersized valve/PWM Compressor.

No Air Flow

If N_Open=100%, ER_new%=0, SH<5 F. and Ti<25 F and N_FL>50%, then either the air is blocked or the fans are not working properly.

Additionally, these diagnostic strategies can also be applied to an electronic expansion valve controller.

The embodiments which have been set forth above were for the purpose of illustration and were not intended to limit the invention. It will be appreciated by those skilled in the art that various changes and modifications may be made to the embodiments discussed in this specification without departing from the spirit and scope of the invention as defined by the appended claims.

## APPENDIX

Pseudocode for Performing Signal Conditioning

```
Repeat the following every Ts Seconds:
Read User Inputs:
  Sampling Time (Ts)
  Control Type (P or T)
  Sensor Mode (Avg/Min/Max)
Perform Analog to Digital Conversion (ADC)
  on all (four) Temp. Sensor Channels
  output data as Counts
Digitally Filter Counts
  Ynew=0.75 Yold+0.25 Counts
  output data as Filtered Counts
Convert Filtered Counts to Deg F.
Test if at least one Sensor is within normal operating limits
  e.g. within -40 and +90 F.
  If none are within limit—Set Sensor Alarm to TRUE
  Else Perform Avg/Min/Max operation based on Sensor
    Mode
If Control Type is NOT a T/P Control Type
  Then End Signal Conditioning Routine (until next Ts
    cycle)
  Else (Control Type is T/P) Do the Following:
Perform ADC on Pressure Sensor Channel
  output data as Counts
Digitally Filter Counts
  Ynew=0.75 Yold+0.25 Counts
  output data as Filtered Counts
Convert Filtered Counts to Psig
Test if pressure Sensor is within normal operating limits
  e.g. within 0 and +200
  If not within limit:
    Set dP=dP Set Pt.
  Else:
    Calculate dP=Pmax-Pmin
Set Sensor Alarm to Conditioned T/dP
End Signal Conditioning Routine (until next Ts cycle)
```

We claim:

1. A diagnostic system for an electronic stepper regulator valve, comprising:

a controller adapted for coupling to an electronic stepper regulator valve, said controller producing a variable duty cycle control signal for adjusting a valve position of said electronic stepper regulator valve, in which said duty cycle is a function of demand for cooling;

a diagnostic module coupled to said controller for monitoring and comparing said duty cycle with at least one predetermined fault value indicative of a fault condition; and

an alert module responsive to said diagnostic module for issuing an alert signal when said duty cycle bears a predetermined relationship to said fault value.

2. The diagnostic system of claim 1, wherein said diagnostic module monitors and compares at least one of the following conditions:

said valve position of said electronic stepper regulator;

an error value percentage indicative of the percentage of sampled error within an accepted offset range for a defined period of time;

a moving average of said valve position for a defined period of time;

a steady state loading percentage set equal to said moving average of said valve position for a defined period of time when said error value percentage is less than fifty percent;

a discharge cooling fluid temperature;

an evaporator coil inlet temperature;

an evaporator coil exit temperature;

a moving average of a difference between said discharge cooling fluid temperature and said evaporator coil inlet temperature;

a moving average of a difference between said evaporator coil exit temperature and said evaporator coil inlet temperature to approximate a superheat value; and

a length of time said evaporator coil exit temperature is less than said evaporator coil inlet temperature during a predefined period of time.

3. The diagnostic system of claim 1, wherein said diagnostic module monitors a percentage of sampled error over a defined period of time.

4. The diagnostic system of claim 3, wherein said predetermined fault value is an accepted offset range.

5. The diagnostic system of claim 4, wherein said diagnostic module determines an error value percentage indicative of said percentage of sampled error within said accepted offset range for said defined period of time.

6. The diagnostic system of claim 5, wherein said diagnostic module determines an error value percentage indicative of said percentage of sampled error within said accepted offset range for said defined period of time.

7. The diagnostic system of claim 6, wherein said alert module issues an alert signal when said valve position of said electronic stepper regulator valve is approximately zero percent for approximately ninety percent of said defined period of time and said error value percentage is less than one hundred percent, said alert signal indicating said electronic stepper regulator valve is over-sized.

8. The diagnostic system of claim 6, wherein said diagnostic module further monitors and compares a superheat value indicative of evaporator superheat.

9. The diagnostic system of claim 8, wherein said alert module issues an alert signal when said valve position of said electronic stepper regulator valve is approximately one hundred percent for approximately ninety percent of said defined period of time, said error value percentage is approximately zero percent, and said superheat value is approximately greater than 5° F., said alert signal indicating said electronic stepper regulator valve is undersized.

10. The diagnostic system of claim 8, wherein said diagnostic module further monitors and compares an evaporator coil inlet temperature value indicative of evaporator coil inlet temperature.

11. The diagnostic system of claim 10, wherein said alert module issues an alert signal when said error value percentage is approximately zero percent, said valve position of said electronic stepper regulator valve is approximately zero percent for approximately one hundred percent of said defined period of time, said evaporator coil inlet temperature value is less than approximately 32° F., and said superheat value is approximately greater than 5° F., said alert signal indicating said electronic stepper regulator valve is stuck open.

12. The diagnostic system of claim 10, wherein said error value percentage is approximately zero percent, said valve position of said electronic stepper regulator valve is approximately one hundred percent for approximately one hundred percent of said defined period of time, said evaporator coil inlet temperature value is approximately greater than 32° F., and said superheat value is approximately greater than 5° F., said alert signal indicating said electronic stepper regulator valve is stuck closed.

13. The diagnostic system of claim 10, wherein said diagnostic module further monitors and compares an evaporator coil exit temperature value indicative of evaporator coil exit temperature.

14. The diagnostic system of claim 13, wherein said alert module issues an alert signal when said valve position of said electronic stepper regulator valve is approximately one hundred percent for approximately one hundred percent of said defined period of time, said error value percentage is approximately zero, said superheat value is approximately less than 5° F., said evaporator coil inlet temperature value is approximately less than 25° F., and said evaporator coil exit temperature value is less than said evaporator coil inlet temperature value for greater than fifty percent of said defined period of time, said alert signal indicating that air flow to an evaporator is blocked or evaporator fans are not operating properly.

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